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# From Virtual to Augmented Reality in Financial Trading: A CYBERII Application

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## **Keywords**

Augmented Reality (AR), Virtual Reality (VR), Mixed Reality, Digital Image Processing, CYBERII, Virtual Financial Worlds.

## **Abstract**

Digital media technology is becoming an integral part of our daily activities, with widespread penetration in various application domains including arts, medicine, education, and commerce. In this paper, we discuss the horizon of emerging digital media technologies in electronic financial trading with reference to a novel application drawing expertise from two important fields of study, namely: digital media (video and image) processing and augmented reality. The application implements technology developed within the scope of the CYBERII project<sup>1</sup>. It features the user insertion in a virtual world of financial indicators for exploration and apprehension. This insertion aims at augmenting the user's perception of the financial market activity and at equipping him/her with concrete information for analysis and dissemination. The insertion of a human in a virtual world of financial indicators serves in reflecting realism through a closer correspondence with real experience, and in extending the power of computer-based technology to better reflect abstract experience.

The paper presents an ergonomic study that considers the potential utility and usability of Augmented Reality (AR) in finance. In order to justify the outcome of this ergonomic study, the paper has to clearly describe the technology under study (CYBERII) and its implementation in finance. This ergonomic study is based on a comparative analysis of the use of Augmented Reality (AR) technology with a counterpart Virtual Reality (VR) technology for the same application. This comparative analysis highlights an added value in the shift from the use of Virtual Reality (VR) to Augmented

Reality (AR) in electronic financial trading. This added value is gained from augmented realism and less constrained interaction. The paper discusses the challenges and rewards of emerging digital media technologies in meeting the needs of electronic commerce applications, in particular electronic financial trading, in terms of the realism of rendering, portability, and widespread usability. It motivates further ergonomic studies involving the evaluation of utility and usability of augmented reality technologies, including the CYBERII technology, in the field of electronic commerce.

## INTRODUCTION

With the growing importance of digital media technology, there is a rising need for developing new applications that harness the use of this technology while meeting various industries' needs. With this motivating aim in mind, this paper considers an application that targets the financial industry and implements novel media technologies developed within the scope of the CYBERII project. The proposed application grew from two earlier financial applications considered by the author. The first application is a virtual reality simulation depicting the role of a monopoly dealer in influencing the true price of a security by setting his/her bid/ask prices to attract buyers and sellers (Maad et al., 2001). The second application, MARILYN (Multimodal Avatar Responsive Live News Caster), consists of a 3D virtual human avatar presenting interactively a multilingual live financial news television program (Maad, 2003a; Maad, 2003b; Maad, 2003c).

While the first application simulated reality, and the second application substituted reality (the interactive television program is presented by a virtual human instead of a real human), the application proposed in this paper is rather innovative and aims at augmenting reality by adopting basic concepts, techniques, and tools developed within the scope of the CYBERII project.

This paper is divided into five sections. The first section overviews the fields of digital image processing and augmented reality and tracks their widespread penetration in various application domains. Section two overviews the CYBERII project, its objective, techniques, and target industries and applications. Section three describes the novel proposed application that implements CYBERII technology. This application features humans insertion and full body interaction with a virtual world of financial indicators. Section four addresses major challenges for the penetration of emerging digital media technologies, such as the CYBERII technology, in the field of electronic commerce, in particular electronic financial trading. The paper concludes with a summary and an outlook

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<sup>1</sup><http://artis.imag.fr/Projects/Cyber-II/>

of the potential and future prospects of the CYBERII technology.

## **DIGITAL IMAGE PROCESSING AND AUGMENTED REALITY**

This section overviews the fields of digital image processing and augmented reality. This quick overview presents a synthesis of the major focus of interest of these two fields of study and their penetration in various application domains.

*Image Processing* (Gur, 2001) deals with images which are two-dimensional entities captured electronically through a scanner or camera system that digitizes the spatially continuous coordinates to a sequence of 0's and 1's.

Digital image processing applications found widespread applications in document and medical imaging, computer vision and industrial applications, remote sensing and space applications, etc..

An *augmented reality system*, is a combination of a real scene viewed by the user and a virtual scene generated by the computer that augments the scene with additional information. The augmentation can take on a number of different forms and its ultimate goal is to enhance the user's performance in and perception of the world (Vallino, 2002).

While Virtual Reality (VR) applications place you inside a digitized environment that closely resembles the real world, Augmented reality (AR) applications combine virtual reality with depictions of real-world objects.

Augmented Reality applications may include among others: medical; entertainment; engineering design; robotics and telerobotics; manufacturing, maintenance and repair; and consumer design (fashion and beauty), etc..

## **ABOUT THE CYBERII PROJECT**

This section overviews the CYBERII project: its objectives, techniques, and target industries and applications.

The CYBERII project aims at simulating, in real-time, the presence of a person (e.g. a TV presenter or a teacher) in a virtual environment. Novel paradigms of interaction are proposed within the context of this project. These paradigms involve full body interaction with the virtual world in real time. This goes beyond traditional modes of interaction

involving the use of mouse, remote control, power gloves, or human sensor equipments.

The CYBERII project adopts a five steps technique to insert one or several humans in a virtual interaction space. It uses the notion of "Active Regions" to initiate the interaction with the virtual world. Actions are triggered upon body interaction with "Active Regions". This interaction may take the form of touching the "Active Region" and may be technically sensed using image analysis techniques that identify a body presence in the "Active Region". As described in (Hazenfratz et al., 2004; Hazenfratz et al., 2003), the CYBERII technology involves the following five steps :

- 1) Multi-camera image acquisition, from different view points, of real moving bodies (see Figure 1 (a) ).
- 2) Reconstruction, modelling, and motion tracking of the acquired bodies and the surrounding environment (see Figure 1 (b) ).
- 3) Rendering of the reconstructed bodies and their surrounding.
- 4) The creation of patterns of interaction in the rendered world using "Active Regions" as shown in Figure 2. Examples of "Active Regions" in a virtual interaction space include: the On/Off Button "Active Region" (see Figure 2 (a) ) and the moving slider (see Figure 2 (b) ).
- 5) Data management and distributed parallel computing to meet the real time and realistic rendering constraints.

The CYBERII technology targets various industries including: (1) the TV industry (e.g. Virtual Sets and online presentations) ; (2) the game industry (e.g. inserting real persons in the game world); and education and entertainment (e.g. allowing visits and presentation of remote places).

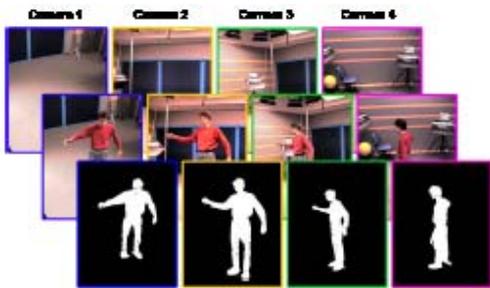
Novel applications that may emerge out of the CYBERII project may include for instance: an augmented reality environment offering new ways to play music through full body interaction with musical notes; and augmented virtual environments for internal design involving the creation of virtual apartments where the user can change the location and color of furnitures.

The proposed novel paradigm of interaction developed within the scope of the CYBERII project, namely full body interaction with active regions, promises universal accessibility to media content. For instance, physically impaired users may find a greater convenience in full body interaction with a virtual scene instead of interaction with a mouse, a keyboard, or a remote control.

**Figure 1 (a)** Image capturing



**Figure 1 (b)** Image-based reconstruction



**Figure 2 (a)** Interaction with: an on/off button



**Figure 2 (b)** Interaction with a slider active region



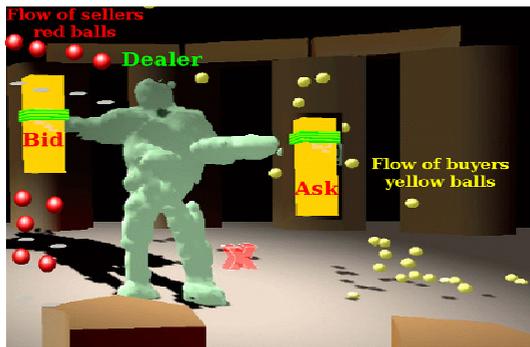
## FROM VIRTUAL TO AUGMENTED REALITY IN FINANCIAL TRADING

This section describes an application of CYBERII technology in financial trading. The application illustrates the implementation of augmented reality in financial trading. Whereas virtual reality technology was previously implemented in financial trading, as described in (Lawrence, 1991; Smith, 1993; Feiner, 1993; Coull et al., 1993), the use of augmented reality in finance was not previously addressed. An added value in the shift from the use of Virtual Reality to Augmented Reality in electronic financial trading is highlighted by comparing the implementation of the proposed financial application using CYBER II technology and a counterpart virtual reality technology. The latter was previously implemented by the author at Warwick University in UK in collaboration with Laboratoire de Robotique de Paris (Maad et al., 2001). This added value is gained from augmented realism and less constrained interaction. The comparison suggests that the novel paradigm of interaction developed within the scope of the CYBERII project, namely "full body interaction" with "active regions", promises a great penetration of augmented reality in electronic financial trading.

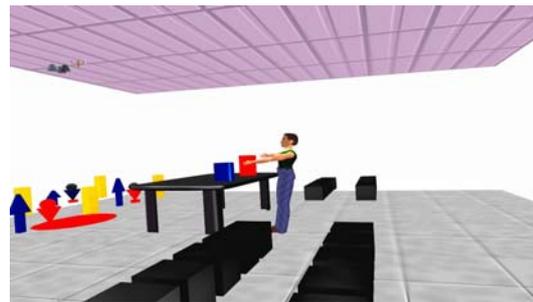
The following paragraphs describe the CYBERII augmented reality financial application and its virtual reality counterpart and establish a comparison between the two applications.

The CYBERII augmented reality financial application involves the insertion of a user (playing the role of a financial dealer) in a virtual world, and the use of the technique of sliders "Active Regions" to enable the body interaction of the user (dealer) to set his/her bid/ask prices for attracting buyers and sellers. The flow of buyers and sellers is abstractly represented by synthetic objects generated in the augmented scene following the user interaction with active regions. Figure 3 shows how the technique of slider "Active Regions" can help the dealer adjust his quotes to attract buyers and sellers. The flow of buyers and sellers is represented by red balls (for sellers flow) and yellow balls (for buyers flow). This flow is triggered through body interaction with the sliders "Active Regions". This illustrates how the CYBERII concept of full body interaction with a virtual environment and the technique of slider "Active Regions" could be used for greater engagement and unconstrained immersion in a virtual world of financial indicators. The simulation augments the real world with perceptual knowledge about bid-ask spread variation and about the flow of traders (buyers and sellers) as a result of this variation.

**Figure 3** The CYBERII financial application



**Figure 4** The Virtual Reality simulation



The virtual reality application described in (Maad et al., 2001) is similar to our proposed augmented reality application in a sense that it involves a user playing the role of a dealer who sets his/her bid/ask spread to attract buyers and sellers. However, it implements a VR technology. The set up for the VR application involves a Silicon Graphics machine running Irix6.5 and using Parametric Technology Corporation's VR modelling tool Dvise. The peripheral includes a 3D mouse as an input device, CrystalEYES glasses for the Stereographic image and 3D auditory feedback. In the VR application, the presence of the dealer in the rendered virtual reality scene is not an image based reconstructed presence but rather a simulated presence. As such the virtual reality simulation described in (Maad et al., 2001) is fully detached from the real world. The user need to wear head mounted displays to have a feeling of immersion in the virtual reality scene. Moreover interaction with the virtual reality world is through power gloves. Figure 4 shows the virtual reality simulation. The dealer manipulates his bid and ask prices (red and blue cylinders) to attract buyers and sellers (informed and uninformed traders). While an increased perception of the financial market activity and of the role of the dealer in manipulating the true price of a security is gained from the use of Virtual Reality in the financial trading application described in (Maad et al., 2001), the isolation from the real world and the constrained interaction (the user need to wear head mounted display and power gloves to have a feeling of immersion in the virtual world) render the experience lived by the user (dealer) less realistic.

The use of augmented reality instead of virtual reality in our proposed CYBERII application aims at breaking the separation of the financial application from the real world and at augmenting its realism. Further reality augmentation to the rendered scene can be gained by adding, as a background, a synthetic depiction of the activity of the financial market. This is shown in Figure 5. Reality augmentation can be also gained by adding a synthesized speech that tells us about the current actions taken by the dealer (the inserted human), the impact of the dealer's action on the flow of traders (buyers and sellers), as well as on the whole financial market activity.

**Figure 5** CYBERII insertion in a Virtual World of Financial indicators (illustrative example)



Table 1 below summarizes the above comparison and highlights the added value from the shift from virtual to augmented reality.

**Table 1.** A comparison of the use of Virtual Reality and Augmented Reality

	<b>Virtual Reality</b>	<b>Augmented Reality</b>
<b>Technology/ tools used</b>	Silicon Graphics machine running Irix6.5 and using Parametric Technology Corporation's VR modelling tool Dvise	CYBERII technology (Augmented Reality using image processing techniques)
<b>Application context</b>	Financial dealer adjusting his bid/ask spread to attract buyers and sellers	Same. Financial dealer adjusting his bid/ask spread to attract buyers and sellers
<b>Human presence</b>	Simulated. A 3D avatar play the role of the human in the VR scene	Augmented. The human is inserted in the Augmented scene using image reconstruction techniques
<b>Medium of interaction</b>	Head mounted display – power gloves	Unconstrained full body interaction with active regions
<b>Degree of interaction</b>	Constrained by the medium of interaction	Unconstrained – open ended free movement
<b>Realism</b>	Closed world simulation detached from reality	Augmented reality – closer to reality – The augmented world involves a virtual scene augmented with human presence (the human is inserted using Digital Image Processing)
<b>Added value</b>	Increased visual perception constrained by the medium of interaction	Unconstrained greater perception
<b>Experience lived by the user</b>	Virtual	Real
<b>Overall</b>	Provides an enhanced 3D simulation and navigation of the financial market	Greater realism through a closer correspondence with reality – Augmented user perception of the financial market activity.

Future research related to the development of the CYBERII project and its application described in this paper focuses on improving the realism of the rendered augmented scene. That is improving the appearance and realism of the rendered humans and non-human objects in the augmented scene.

## CHALLENGES AND PROMISES

Despite the great promises of their uses in the finance domain, current media technologies (including digital image processing and augmented reality technologies) are not yet mature to meet industry standards in terms of the realism of rendering, timeliness, portability, and widespread usability.

Many challenges may face the use of the application described in this paper by the finance community. Three of these challenges are discussed in this

section, these include: 1) the maturity of the technology to serve an industry need; 2) the choice of an appropriate medium of delivery of the application (TV, Internet, PC, or other home/office device); and 3) the interest of users, from among the financial community, in having access to such type of an innovative technology.

**1) The maturity of the technology:** Earlier empirical studies conducted in (Maad, 2003a) reveals the limitation of 3D and audio technologies in meeting standards for authoring interactive television content. This is attributed to the lack of realism of the media content authored using the prevalent technologies. Concerning our proposed CYBERII application, we can see that the rendered human(s) in our application lack realism as shown in Figures 4, 5 and 6. This may have an impact on the appeal of the current technology to the financial community.

**2) The choice of the medium of delivery:** Four potential medium of delivery for our application can

be considered, these include: the PC, the Internet, the interactive television (ITV), or other home/office devices. However a closer look at the hardware setup of the CYBERII project (described in (Hazenfratz et al., 2004; Hazenfratz et al., 2003) as a networked set of 4 cameras, 4 PC, and one supercomputer) reveals great challenges in the portability and interoperability of the CYBERII technology.

3) *Users interest*: The widespread penetration of the CYBERII technology among the financial community depends on the current demand for an application such as the one described in this paper. If this demand ever exists then it would be limited among a few novice community who fancy new technologies.

In face of these challenges, more research work, beyond the development of the technology, need to be undertaken to justify the usability and utility of the CYBERII technology in meeting various industries' needs.

## CONCLUSION AND FUTURE OUTLOOK

This paper presented a novel application of media technology in electronic financial trading. This application features the insertion of a human in a virtual world of financial indicators. The considered application implements technology developed within the scope of the CYBERII project. Following a brief introduction of the fields of digital image processing and augmented reality, the paper presented an overview of the CYBERII project. The paper compared the proposed CYBERII financial application to a counterpart application that uses virtual instead of augmented reality technology. The comparison highlighted an added value in the shift from the use of virtual to augmented reality. This added value is manifested in greater realism and less constrained interaction. Major challenges facing the penetration of the proposed application in the financial industry are addressed. The CYBERII technology, when fully established, promises greater accessibility to computer based technology. More research work is needed to highlight the usability and utility of the CYBERII project. This would involve the development of the technology and the consideration of further applications.

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